Exploring the effects of commuting on workers' satisfaction. Evidence for Spain

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This article examines the relationship between commuting time and satisfaction with different life domains. Based on data for Spain, the results show that commuting time exerts a negative impact on all areas of satisfaction for male and female workers, and that longer commutes affect women's satisfaction disproportionally. Using public transport and walking/cycling worsen this effect, as do higher degrees of urbanization and population density. According to the evidence, whose robustness is tested in several ways, the negative effect of commuting time on satisfaction is greater for lower income workers, although for them the Great Recession moderated this effect.

Key words: subjective well-being; life satisfaction; job satisfaction; commuting.

JEL Codes: I3, J28, R4.

1. Introduction

A rapidly expanding body of literature in different scientific fields focuses on the empirical analysis of the determinants of subjective well-being (SWB) (see e.g. the reviews by MacKerron, 2012, De Vos et al., 2013, and Diener et al., 2017). The reasons are the growing availability of databases with microeconomic information on satisfaction and personal characteristics, and the acceptance of using variables of a subjective nature to measure individual well-being (Blanchflower and Oswald, 2004).

Given the monetary and time costs involved, and its repetitive nature, work-related commuting is one of the factors most likely to affect individual SWB. Commuting time has been

found to exert significant negative effects on a wide range of labour, health and personal life aspects. Unsurprisingly, commuting has in fact been identified as the daily activity that produces fewest positive feelings and most negative ones (Kahneman et al., 2004). Such results are nuanced, however, by findings according to which, at least for certain individuals, commuting might also be associated with positive utility deriving from e.g. the activities conducted during the commute (Redmon and Mokhtarian, 2001, Mokhtarian et al., 2001; Ory and Mokhtarian, 2005; Lyons et al., 2010; St-Louis et al., 2014), and by activity-based travel demand models (Ettema et al., 2010). More complex interpretations are thus possible.

Beyond an individual point of view, the commuting phenomenon is of great relevance for society as a whole, given the social costs related to congestion, energy consumption, pollution or noise among others. Accordingly, findings from studies have the potential of supporting policymakers in designing better transport and land use policies, since individual attitudes and choices are crucial in all spheres of urban planning.

A decade ago, Stutzer and Frey (2008) proposed a conceptual framework to analyse the relationship between commuting and SWB based on the microeconomic theory of location, which occupies a central place in urban and regional science. According to the Alonso-Muth-Mills-type urban models, in equilibrium, individuals should only choose jobs that entail a longer commute (its pecuniary and non-pecuniary net costs) if such a choice is compensated by a better employment opportunity and/or improved prospects in the housing market. The authors derived two testable predictions from this. First, even if commuting in itself was considered to produce net disutility, the compensation argument implies that it should not affect individual well-being (which is considered a proxy for the economic concept of utility and is measured as life satisfaction) if it was measured more comprehensively, and therefore no systematic correlation between people's commuting and their reported life satisfaction should be found. Second, the effect of commuting on satisfaction should vary across different life domains. More specifically, their prediction is that if equilibrium is met, a positive impact of commuting duration can be expected in the work and

residential domains (since a longer commute allows access to better jobs and dwellings), while the opposite would apply to other areas of life. This seminal work was the first of a series of studies on these issues. Such limited literature, which is reviewed in the next section, has dealt with the first of Stutzer and Frey's (2008) testable propositions, namely that referring to overall life satisfaction, for which contradictory results have been reached, has provided a rich, albeit still incomplete, explanation of the factors that mediate the relationship between commuting and SWB.

In this article, we contribute to the evidence available to date in several areas. First, unlike the studies that followed-up Stutzer and Frey's (2008) proposal, we re-examine their hypothesis that, according to the location theory, commuting should have opposing effects on satisfaction in different life domains. Thus, we examine the potentially positive impact of commuting on job satisfaction and satisfaction with housing conditions, and its negative impact on satisfaction with personal life and leisure time, respectively. Second, although we draw on the results of prior, directly related research to incorporate a relevant set of variables that have been found to mediate those effects (gender and travel mode, among others), we also introduce three main aspects that we argue are very relevant for the examination of how the commuting-SWB interaction is shaped: certain territorial characteristics (degree of urbanisation and density); income (although income has typically been considered as one of the control variables in the analysis of the commuting duration-SWB relationship, its interaction with commuting time has been much less explored); and the effect of the Great Recession (i.e. whether the worsening of the economic environment and, more specifically, the dramatic rise in unemployment, has influenced the individual assessment of commuting in terms of satisfaction).

We also enlarge the geographical scope of analysis in the literature to date by adding a case from southern Europe – Spain – to the available international evidence. This is relevant not only because commuting is an eminently territorial phenomenon, and it is therefore plausible that marked differences exist between countries in terms of the relationship analysed in the article (Dickerson et al., 2014), but also because until now, research has focused on an extremely limited

group of countries, as is apparent in the following section, with an over-representation of the British case. Within this context, Spain, one of the largest EU countries, is characterized by marked differences in some economic and institutional factors characterizing both the labour and the housing markets. Thus, for example, in Spain there is a high share of home ownership, which increases transaction costs. A further difference involves unemployment. Spain traditionally ranks among the highest unemployment levels in the OECD, and was one of the countries where unemployment rose most due to the Great Recession, making it an interesting case study. Moreover, previous research suggests that cross-country quality differentials in travel modes (e.g. road maintenance, or levels of crowding, frequency and reliability in public transport) could influence the way such modes mediate the commuting-SWB relationship, thus reinforcing the need for expanding the range of countries under study.

The empirical analysis is based on a pool of microdata from the *Survey on Quality of Life in Employment* and is based on multivariate regression. We thoroughly tested the results' robustness based on three alternative approaches: the unconditional quantile regression method proposed by Firpo et al. (2009), to examine whether commuting effects varied across the different quantiles of the satisfaction distribution variables; replicating the analyses using an alternative measure of the commuting variable, to check any possible measurement error in this variable and to account for a possible non-linear relationship; and estimating an extended version of the model with a wide set of controls on job characteristics, to account for any potential problem associated with the omission of relevant variables.

The structure of the article is as follows. The following section reviews the literature relating to the impact of commuting on workers' satisfaction. The third section describes the database and the main variables of interest. The methodology is presented in the fourth section and the results of the empirical analysis in the fifth. We conclude with the main findings of the research.

2. Literature Review

Literature on the determinants of individual well-being and the effects of commuting on different aspects of personal life is relatively ample. Empirical evidence relating to the relationship between commuting and individual well-being is, however, more limited. Before reviewing such literature it is worth stating that, given the focus of the research, it is the so-called cognitive (vs. affective) aspect of SWB – satisfaction with life – that draws our interest. This concept is considered a measure derived from reflective reasoning (Diener, 2009), and therefore echoes the economic concept of utility, which is central here.[i] As pointed out by Ettema et al. (2010) and De Vos et al. (2013), previous research shows that cognitive SWB can be decomposed into specific life domains (family life, work, leisure, and so on). Such domains are also cognitive in nature, as they are based on evaluative beliefs about one's life (Schimmack, 2008). However, in the rest of this section we do not restrict our review to the literature on the relationship between commuting and satisfaction but adopt a wider perspective to gain an insight on these related issues.

In their seminal study, Stutzer and Frey (2008) examined the notion of equilibrium in classical urban and regional economic theory. This postulates that individuals would only travel longer distances to and from work if they were compensated by a more rewarding job or a better living environment. The first implication put forward is that owing to such compensation, commuting duration should be unrelated to global SWB. Their second testable proposition sophisticates the first one by reasoning that when individuals are asked about their global SWB they may not be able to appropriately balance the different life domains involved in such judgment. This should be easier, however, if they were asked separately about each domain. Thus, the expected sign in the relationship between commuting duration and satisfaction is positive for the job and residential domains (where the compensation is expected to be clear), and negative in other domains. Their own empirical analysis based on German data refuted both predictions and led them to conclude that commuting is in fact an activity without compensation (the 'commuting paradox'). The authors explored several explanations for these results and discarded the existence of a travel mode's moderation effect or the existence of intra-household compensation. They also

hypothesized that poorer people had less chance to optimize their job/housing choice due to powerful agents in the housing and labour markets, so their commutes would end up not being compensated. They only found weak evidence of this effect however. They then proposed two behavioural explanations: on the one hand, people may rely on inadequate intuitive theories when they predict how commutes (and e.g. the stress associated with it) will affect them and are therefore incapable of correctly assessing SWB implications. On the other hand, some people may have limited self-control and insufficient energy, making them unwilling to go through the trouble of identifying alternative jobs or dwellings that will improve their perceived situation, so they simply stagnate in a state where their commute is longer than their optimal level.

Stutzer and Frey (2008) do not detail the reasons for expecting a negative relationship between commuting duration and satisfaction in other domains aside job and housing, although they probably associate this with experienced time restrictions (as suggested by e.g. the resource drain model – see Edwards and Rothbard, 2000), since the time devoted to commuting cannot be spent on other activities. Thus, for example, previous research has found that commuting duration is negatively related to time spent with one's spouse and children, to social activities, and to a subjective evaluation of social life (Christian, 2012; Besser et al., 2008, and Delmelle et al., 2013, respectively). A second explanation could be an alternative mode of interdomain transfer (Novaco et al, 1990) according to which e.g. the stress and other negative feelings deriving from commuting could reduce satisfaction with e.g. family life (see note i).

Reference to these two factors is common in the wider literature on satisfaction with commuting. Reviewing the literature on travel satisfaction is beyond the scope of this paper (for a thorough review see e.g. De Voos et al, 2013), but authors such as Bergstad et al., (2011) and Olsson et al. (2013) have shown that there is a positive relationship between travel satisfaction and SWB. Recent transport literature has gone beyond the traditional cost-benefit analysis (where reducing commuting time is fundamental) to explore activity-based travel demand models (Ettema et al., 2010), in which SWB plays a significant role. Ettema et al. (2010) explore how travel affects

SWB (not necessarily negatively) through actual experiences while travelling: travel allows participation in activities, and travel time pressure affects how those activities are experienced. Recent studies examining these issues include Abou-Zeid and Ben-Akiva (2012), Bergstad et al. (2011), and Morris and Guerra (2015b). The literature on travel satisfaction emphasises the mediating role of objective and subjective factors on the relationship between commuting duration and SWB. Given the nature of our article, two objective contextual factors, travel mode and congestion, are relevant here. Thus, a recent literature review (Ettema et al., 2016) shows on the one hand that satisfaction with active travel modes is higher than car travel and public transport, and on the other, that active modes and (good quality) public transport are good alternatives to car travel. Congestion, the second factor, leads to additional costs to commuting in terms of e.g. fuel consumption, exposure to pollution, stress, and individual control (Higgins et al., 2017). Accordingly, Higgins et al. (2017) find evidence indicating that, although improvements in travel time are relevant for increasing commute satisfaction, reducing travel in congested conditions matters most.[ii]

The remainder of this review focuses on the literature that deals directly with the impact of commuting on SWB. The vast majority of these studies pursue, in a tacit or explicit way, the testing of Stutzer and Frey's (2008) first proposition on equilibrium (where the relationship between commuting duration and global SWB is expected not to be significant). These studies have identified key aspects that are interpreted as moderators, mediators or expressions of heterogeneity in responses from different groups of individuals depending on the conceptual framework adopted as well as the research design (and associated techniques).

A first group of works roughly confirm the empirical results by Stutzer and Frey (2008) regarding the negative relationship between commuting time and SWB. They focus on how alternative uses of time and especially congestion influence this relationship. These include Choi et al. (2013), Nie and Souza-Poza (2016) and Hilbrecht et al. (2014), who examine the US, Chinese and Canadian cases, respectively. Thus, the first of these studies underlines the role of congestion

and its influence on commuting time, while the second shows that the relation between commuting duration and happiness is mediated by the time spent on daily activities, particularly sleep. In line with these results, in their analysis based on the resource drain model mentioned earlier, Hilbrecht et al. (2014) found that commuting time reduces life satisfaction and that this relationship is mediated by both other time use categories and perceptions of traffic congestion. This conclusion reinforces the idea that not only the quantity but also the quality of commuting time is relevant.

On the other hand, many studies on this issue have focused on travel mode. Thus, Roberts et al. (2011), who use a subjective evaluation of individuals' health (GHQ) as the dependent variable, analyse the UK case and find that bus travel and being a car passenger reduce the otherwise negative effect of commuting on satisfaction compared with driving a car. Moreover, in alternative estimations where modes are aggregated to approximate the degree of control over the journey, active modes (i.e. car, motorcycle, cycling and walking in their study) are found to worsen the adverse effect of commuting on GHQ, while passive modes (public transport and car passenger) slightly attenuate it. Martin et al. (2014) also examined the British case and found a significant positive association between psychological well-being, active travel (cycling/walking), and public transport (train/bus/coach) when compared with car travel. Both British studies are at odds with a third UK study by Dickerson et al. (2014) who examined the interactions between commuting mode and commuting time and concluded that none were significantly linked to life satisfaction. In his analysis of the Swedish case, Olsson et al. (2013) found that satisfaction with commuting by car exceeded that of using public transport, and reported positive effects of walking and cycling, attributed to the intrinsic enjoyment of exercise, as well as the friendly environment associated with such activities in Sweden. However, this result disagrees with that of Kroesen (2014) and the already quoted study by Nie and Sousa-Poza (2016). Thus, the first of these articles, on the Dutch case, concluded that a negative albeit weak link between commuting duration and happiness could be established for those commuting by bicycle (this relationship is mediated by reduced social activity), although for car commuters there was no association between both

variables, and no effect was observed in either of these two commuting modes in terms of job satisfaction. In turn, Nie and Sousa-Poza (2016) examined the potential role of travel mode and did not find any evidence that active commuting (walking and cycling in their analysis) was associated with an increase in SWB.

To conclude this review, three of the studies focusing on the UK examined how the impact of commuting on SWB was mediated by gender. Thus, Roberts et al. (2011) found that a longer commute was associated with lower levels of individual well-being only in the case of women. The authors attributed this to the fact that women were more sensitive to long commutes because of their greater daily domestic and family burdens. Such a result does not, however, seem to hold when analysing the same database using life satisfaction instead of GHQ, as in the case of Dickerson et al. (2014). According to these authors, lower life satisfaction was not related to a longer commute neither for male nor female workers. In contrast, commuting time was related to lower satisfaction with leisure time. Finally, in his analysis of dual career households (which focuses only on highly skilled occupations), Wheatley (2014) concluded that long commutes were negatively related to job and leisure satisfaction for men, and that this relationship was, however, more complex for female workers.

Overall, this review reveals that there are notable discrepancies in previous study findings. This has led some authors like Dickerson et al. (2014) to conclude that the 'commuting paradox' is not generalized and may depend on specific contextual characteristics, such as cultural differences between countries, and therefore a wider range of national cases should be studied. These discrepancies may be also explained by the noticeable diversity in conceptualizations, availability of databases/variables, and the quantitative techniques used, among other factors. In any case, several key variables have been identified as mediators in previous studies and will accordingly be considered in our analysis. Among these variables are gender and travel mode (amply treated in the literature, although no consensus on their effect has been reached) and congestion/urban form (less addressed in previous specific research but whose effect on the

commuting-satisfaction relationship is less controversial). We take all these variables into account in our study. Based on the location theory framework, we examine the effect of commuting duration on satisfaction with different life domains and address two additional specific issues: the influence of income levels and how the economic crisis shapes the commuting-satisfaction relationship.

3. Data and Variables

The empirical analysis is based on the *Survey on Quality of Life at Work* (*ECVT* by its Spanish acronym), that Spain's Ministry of Employment and Social Security conducted annually between 1999 and 2010. This survey is composed of independent cross-sections for each year. It covers people in work based on an annual sample size of around 8,000 workers[iii] and constitutes Spain's single source of data required for this research (namely, with information on commuting, on satisfaction with different life domains, and on the sociodemographic characteristics of individuals and their spatial environments).

The dependent variables in the analysis measure levels of worker satisfaction with four specific life domains (work, housing, personal life and leisure time). In all cases the variables derive from individuals' answers to questions about their level of satisfaction measured on a 0-10 scale (for the detailed definition of the variables, see Table A.1 in Appendix A). Commuting, the primary independent variable of interest, corresponds to the usual time taken to travel between home and work measured in minutes. A full range of workers' individual and family characteristics was considered for the other explanatory variables: sex; age (and its square); nationality (Spanish or foreign); highest level of education (primary education or less, secondary education and higher education); the presence of at least one child aged 14 years or under in the household; marital status (whether the workers live with their partner; and whether this partner is working or not); and monthly household income.

One of the main aims of the research is to examine the extent to which the relationship between commuting time and workers' satisfaction is affected by economic cycles. We thus created a dummy, reflecting whether the survey's observation year corresponded to a stage of economic crisis as opposed to a prior expansion phase (i.e. 2008-2010 vs. 2007). It is well documented that the Great Recession and its associated rise in unemployment led to increased workload, and that staff and wage reduction increased workers' stress and impacted their mental health (Mucci et al, 2016). Accordingly, the negative effect of unemployment on SWB may not be restricted to the unemployed but extend to the rest of the labour force. Thus, Blanchflower et al. (2013) concluded that higher unemployment rates reduced satisfaction, especially among those who are probably more precariously employed, which could be associated with increased uncertainty and fear of unemployment (Graham et al., 2010). It is also possible, however, that being employed during a recession has an impact on satisfaction with the work commute (Olsson et al., 2013), therefore the net effect of the crisis on commuting duration-SWB is difficult to predict. In any case, Spain is one of the OECD countries where unemployment increased most during the recent crisis, and its impact on the relationship between commuting and job satisfaction is therefore likely.

We also included different territorial variables in the analysis: the region of residence (there are 17 regions in Spain); the size of the municipality (five different categories of municipalities were considered, from less than 10,000 inhabitants to over one million inhabitants); and population density (measured in inhabitants per square kilometre and approximated as the average population density of the municipalities of a similar size in the individual's region of residence). This set of variables helped identifying the individuals living in highly urbanized environments. This is relevant as it has been argued that certain factors, difficult to control, can crop up during the journey that increase commuting-associated stress, due to unpredictability and a sense of loss of control. The best example is traffic congestion, which is strongly correlated with degree of urbanization.

Other explanatory variables we considered relate to the sectoral structure of the economy (distinguishing between public or private sector employment) and travel mode (we included both the original categories in the variable[iv] and an additional variable that classifies them into 'public' or 'private', since previous research suggests that this dimension can lead to a differentiated effect on overall life satisfaction).

To conclude, we focused our empirical analysis on the most recent ECVT cross-sections available, corresponding to the 2007-2010 period. This period covers both the expansion and crisis stages. We selected it because it was the only period for which the survey provided continuous data on the commuting variable, as it is measured in minutes (in ECVT cross-sections previous to 2007 this variable is categorical and values are provided for a reduced number of intervals, a notable limitation to our empirical analysis). The study sample included employees aged between 16 and 65 years (62 observations were excluded). Employees reporting a commute longer than three hours were also excluded (8 observations). The final sample was composed of 25,957 employees for the four-year pool, which represents 99.7% of the total number of employees surveyed. Figures A.1 and A.2 and Table A.2 of Appendix A contain descriptive evidence on the main variables of interest in the analysis (commuting and satisfaction with the four different life domains considered), as well as the rest of the control variables.[v]

4. Methodology

Given that the four dependent variables considered in the empirical analysis correspond to measures of satisfaction in different life domains for the same individuals, we used the multivariate regression estimation method. This linear method allows the disturbance terms to be correlated across equations. It constitutes a special case of the seemingly unrelated regression method in which all equations share the same set of explanatory variables. Although it is roughly equivalent to estimating each equation separately using OLS, it has several additional advantages (see e.g. Draper and Smith, 2014). Hence, we can jointly estimate all the equations, correctly estimate the

between-equations residual covariances, and thus develop tests on the joint significance of coefficients across equations.

It must be noted that we treated the dependent variables that measure satisfaction in different life domains as continuous cardinal variables in the overall empirical analysis. Other studies on the determinants of subjective well-being use ordered logit or probit estimation models, as they considered that decision process alternatives when measuring satisfaction subjectively implicitly express an order of utility and therefore have an ordinal character (see MacKerron, 2012), However, it is a widespread and rather standard practice to treat them as continuous variables when the number of values taken by this variable is high. On the other hand, it is worth noting that results obtained from models based on the cardinality of subjective well-being measures generally resemble, in practice, those based on ordinality (Ferrer-i-Carbonell and Frijters, 2004). They also have the additional advantage of producing estimations which are more easily interpretable.

We estimated four main basic models for the total sample. The dependent variables were: satisfaction with one's job, housing, personal life and leisure time, and the set of explanatory variables included sociodemographic characteristics. We carried out further disaggregated analyses for the four domains of satisfaction based on economic cycle stage, spatial characteristics, income, gender, and travel mode.

Furthermore, different alternative models were estimated (section 5.2) to verify the robustness of the results obtained. For the first one, we used an alternative measure of the commuting variable (treated as a dichotomous variable using workers' average commuting as a threshold). We then estimated a second extended model of job satisfaction, including an extensive set of controls on jobs' objective and subjective characteristics. We conducted the last of the three robustness tests based on the hypothesis that commuting effects on satisfaction domains may vary across their distribution. To do this, we used the estimation method of unconditional quantile regression proposed by Firpo et al. (2009) (see Appendix B).

5. Results

5.1. Multivariate analysis

As stated in the methodology section, we ran the bulk of the econometric estimations through multivariate regression using individual satisfaction in four life domains (job, housing, personal life and leisure time) as the dependent variables and common model specifications for all satisfaction domains. The independent variables we considered in such general specifications were individual and family attributes (sex; age and age squared; nationality; highest level of education; the existence of children aged 14 years and under in the household; marital status; and household income).

The evidence obtained in the general analysis (Table 1) shows that a longer commute is significantly associated without exception with sizeable lower levels of satisfaction in the four domains considered. Additional evidence (not shown) shows that residuals are correlated across equations (the coefficients of correlation of residuals are in the 0.2 to 0.3 range and are statistically significant at conventional levels), which confirms the convenience of estimating via multivariate regression. Moreover, tests on the joint significance of coefficients across equations also confirm that the coefficient of the commute's variable is different from zero in all equations at conventional levels of significance (F=106.7; p-value=0.000). Hence, this overall evidence does not support Stutzer and Frey's (2008) hypothesis based on the microeconomic theory of location: the negative relationship between commute duration and satisfaction with other domains of life does not seem to be offset by a positive relationship with the work and residential domains.

[INSERT TABLE 1 HERE]

One of the main aims of our research was that of examining the potential effect of both the economic crisis and spatial characteristics on the relationship between commuting and workers' satisfaction. Therefore, the next step of the analysis consisted in examining the effect of commuting on employees' satisfaction, distinguishing between the potential impacts of these two

factors (Table 2; due to space limitations, the table only includes the coefficients of the main variables of interest). The estimated coefficient for the interaction between commuting time and the period of economic crisis was positive and statistically significant at conventional levels in the model for job satisfaction. This suggests that the negative effect of commuting on job satisfaction was less intense during the Great Recession, when unemployment was growing. Consequently, it depended on the phase of the economic cycle. According to the estimated coefficient of an additional interaction with household income levels (Table 2), this effect seemed to be apparently stronger for individuals whose household income was lower than average. We explored this issue in greater detail by clustering our sample into two groups according to whether their household income was above or below the average. Consequently, Table A.3 in Appendix A shows that the negative effect of commuting duration on satisfaction is much higher for low income individuals (no differences according to gender were observed here), which agrees with the idea that poorer workers have less chance of optimizing their job/housing choice due to powerful agents in the housing and labour markets, so that their commutes end up not being compensated. Interestingly, however, for them, the crisis attenuated such an adverse effect for poorer workers but did not moderate the commuting duration-SWB relationship for higher income individuals. This result supports the hypothesis that being employed in a recession affects satisfaction with the work commute, which would be compatible with the evidence of downward adaptation/expectations found by Graham et al. (2010) - who analysed the effect of the Great Recession on well-being in the U.S - but restricts this effect to lower income workers (who, on the other hand, were most affected by the rise in unemployment during the crisis).[vi]

[INSERT TABLE 2 HERE]

Table 2 also shows that commuting's negative impact on satisfaction greatly increases with both population density and municipality size, reaching a peak in cities over one million inhabitants (namely Madrid and Barcelona). Hence, this evidence confirms overall that living in

more urbanized environments exacerbates the negative impact of commuting on all areas of satisfaction, which could be related to a higher incidence of traffic congestion and associated individual stress derived from unpredictability and the individual's lack of control, ceteris paribus, over commuting time. Evidence in the bottom rows of Table 2 also suggests that, although working in the public sector is associated with much lower impacts of commuting on all domains of satisfaction, a negative net effect of commuting time on satisfaction persists after controlling for sectoral distribution of employees.

In addition to this, we performed a separate analysis for men and women. The results obtained (Table 3) indicate that, although female workers tend to exhibit higher levels of job satisfaction compared with men with the same characteristics (Clark and Oswald, 1996, and Clark, 1997), the impact of commuting on such levels of job satisfaction does not vary with gender, inasmuch as the coefficient of the interaction between commute duration and being a woman does not take a value different from zero. Moreover, that coefficient is negative in the case of satisfaction with housing, thus reinforcing the negative effect of commuting duration in that domain. This evidence suggests overall that the hypothesis of Stutzer and Frey (2008) that commuting has negative effects on certain areas of satisfaction but positive ones on others is not verified in the Spanish case for either male or female workers.

[INSERT TABLE 3 HERE]

Lastly, we examined the potential impact of travel mode, as the effect of commuting on employees' satisfaction can vary depending, inter alia, on the individual's degree of control over the commuting experience, the required physical effort, or the possibility of performing other activities during the trip. To this end, in addition to a full disaggregated analysis, the estimation was also conducted distinguishing between public and private modes of transport (Table 4). The evidence shows that individuals using certain modes of transport such as bus, metro/tram, car (as a passenger) or walking/cycling experience a more negative impact of commuting in almost all

the domains of satisfaction compared with those whose travel mode is driving a car. Consequently, although using public transport is associated with a moderation of the negative relationship between commuting time and satisfaction with leisure time (which would lend some support to the idea that those trips can be taken advantage of to perform activities such as using electronic devices, reading or listening to music), it is negatively associated with almost all the other life domains, including work and housing.[vii] Overall, this evidence concurs with the hypothesis put forward in previous studies that mode of transport can be very relevant in the relationship between commuting and satisfaction.

[INSERT TABLE 4 HERE]

5.2 Testing robustness

We performed a range of tests on the results obtained to contrast the robustness of the foregoing evidence. First, we replicated the analysis using an alternative measure of the commuting variable, to control for the possible existence of measurement error in this variable due, among other factors, to individuals' tendency to round off when reporting the length of their commute (Roberts et al., 2011), which translates into a high number of observations around certain values (Figure A.2). Thus, we replaced in this analysis the original variable commuting time with a dichotomous one that captured whether the individual's commuting time was above or below the average. [viii] Table A.4 of Appendix A summarizes the evidence obtained. The results obtained generally confirm those in Section 5.1. Nevertheless, being a woman noticeably reinforced the negative impact of commuting in the four domains of satisfaction, suggesting a differentiated impact of commuting according to gender when it comes to relatively longer commutes.

Second, we estimated an extended version of the model where job satisfaction was used as a dependent variable, including an extensive set of controls on job characteristics. The results obtained with this more complete specification confirmed the negative relationship between commuting and job satisfaction, since the coefficient of the variable that measures commute length

remained negative and statistically significant at conventional levels (Table A.6 of Appendix A). Moreover, the estimated coefficients associated with individual characteristics and the objective and subjective attributes of jobs were overall in line with the usual findings in previous studies analysing the determinants of job satisfaction.

Finally, we tested whether the effect of commuting on the different satisfaction domains varied according to the level of these variables (Table A.7 and Figure A.3 of Appendix A). We conducted this analysis using the unconditional quantile regression method (Firpo et al., 2009) to examine the effect of commuting on different quantiles of the satisfaction distribution variables. In short, the evidence obtained confirms that commuting's negative impact on different satisfaction domains tended to be relatively uniform for all the levels of satisfaction, with the sole exception of higher levels of satisfaction, where it was slightly more pronounced.

6. Conclusions

In our article we examine the relationship between commuting duration and the satisfaction of Spanish workers in different life domains. Our research follows in the line of numerous recent studies that examined the determinants for individual SWB and the consequences of commuting separately. Very few works, however, have addressed the specific relationship between commuting length and satisfaction. It is important to improve our knowledge of this relationship since workers dedicate a significant amount of their time to commuting. Moreover, the pecuniary and non-pecuniary net costs of commuting are widely recognized, both for individuals and for the society as a whole, and there are, therefore, implications in many specific public policy domains.

Based on the theory of location, according to which longer commutes are compensated through access to better jobs or housing alternatives, previous studies have hypothesized that commuting should exert a neutral effect on overall satisfaction, and that gains in satisfaction in some domains (work, housing) counterbalance losses in other spheres, resulting in 'stress that pays'. The few (and geographically concentrated) studies aimed at testing such hypotheses have

mainly considered the effect of commuting duration on overall SWB. They do not provide a comprehensive examination of such an effect on specific domains. Moreover, they do not present conclusive evidence on the relationship, and clear cross-national differences (attributed to cultural and institutional factors) can be found between them. Nonetheless, these studies have identified several relevant variables that could moderate such a link. In contrast to previous research, we re-examine this issue in our study: we consider four life domains and test potential positive impacts of commuting on work and housing, and a negative impact in other domains (personal life and leisure time), in line with the predictions based on location theory. Our analysis is the first to be conducted for a Southern European country, Spain. We argue that this is a relevant case study given its peculiarities in terms of both the housing and labour markets; the latter can hinder the individual adjustments that are crucial for the equilibrium condition in location theory to be fulfilled. Thus, for example, Spain is characterized by comparatively higher home ownership levels, unemployment rates, fixed-term contracts, and income inequality.

The evidence obtained shows that for Spanish employees commuting duration is negatively linked to satisfaction in all the domains under study, including job satisfaction and satisfaction with housing. Therefore, the results are not consistent with the 'stress that pays' hypothesis. Furthermore, such a relationship was observed for both private and public sector employees (although in the latter case the effect is considerably lower), as well as for male and female workers. Our findings are therefore at odds with the UK-based study by Dickerson et al. (2014) - who found that commuting was not related to lower life satisfaction for either gender -, but also with those of Roberts et al. (2011) and Wheatley (2014) - who identified a distinctive gender effect. Furthermore we find, in contrast with Dickerson et al. (2014), that travel mode is a significant dimension given how it affected the commute duration-SWB relationship. Thus, compared to the predominant mode (driving a car), using public transport, walking/cycling or traveling as a car passenger worsens that relationship in all domains (except the public transport/satisfaction with leisure time combination). Our analyses put a special focus on three possible moderating effects

hardly addressed in the literature until now: income, the stage of the economic cycle and the territorial dimension. In this vein, our results suggest first that the negative effect of commuting duration on satisfaction is more acute among those belonging to low-income households, therefore supporting the hypothesis proposed by Stutzer and Frey (2008) that poorer individuals experience greater difficulties in optimizing their job/housing choice. Second, we find that for such low-income households, the Great Recession exerted a moderating effect on the negative relationship between commuting time and satisfaction, while such an interaction was not significant for higher income individuals. Previous research (Blanchflower et al., 2013; Mucci et al., 2016) indicates that the crisis-induced increase in unemployment rates led to a fear of unemployment that reduced satisfaction even among those holding a job, especially the precariously employed. Our results suggest that the negative relationship between commuting time and satisfaction may have been partly offset by the higher value attached to having a job after the macroeconomic shock and its massive impact on Spanish unemployment rates. Although according to our study this effect is restricted to low-income workers, this result gives support to the proposition by Olson et al. (2013) that satisfaction with being employed in a recession may be transferred to satisfaction with the work commute, although this possibility was not explicitly tested in their own study. Lastly, we also show that higher degrees of urbanisation and population density tend to exacerbate the negative relationship between commuting and satisfaction, which could be associated with a higher incidence of traffic congestion and the associated individual stress derived from unpredictability and the individual's lack of control. In that sense, our results are compatible with those reached by Choi et al. (2013) and Hilbrecht et al. (2014) for the US and Canada. On the other hand, we roughly confirmed our findings based on three methods to test their robustness. These further suggested that female workers are more sensitive to longer commutes than their male counterparts, and that the negative impact of commuting on satisfaction tends to be slightly more pronounced in the higher levels of satisfaction.

Overall, the results are at odds with the view that rational workers' commutes (and its associated net costs) are compensated by either a rewarding job or better housing, so that their well-being or utility is equalized over all combinations of alternatives in the labour and housing markets. By questioning the equilibrium location theory, the evidence derived from the present study supports policy actions aimed at acting on urban structure (to enhance the spatial match between job and residential locations), as well as in the field of transport (with a focus not only on average commuting times but also on travel mode, where cross-national differences suggest the existence of quality issues that should be addressed, and on congestion), with a view to optimizing the aggregate travel behaviour of commuters. According to our findings such interventions have the potential not only of reducing the social costs mentioned above, but also of increasing individual satisfaction in different life domains, including work and housing. Our results also suggest that some groups of workers could benefit from targeted measures. This is e.g. the case of female workers (although a gender effect has not been found in the relationship of interest, longer commutes affect women's satisfaction disproportionately), and lower-income individuals. Thus, although the effect of the Great Recession moderated their disproportionally negative effect and brought it in line with higher income households, it is to be expected that, once the economy recovers, the attenuating effect of 'employment gratitude' will disappear, and there will then be scope for policy actions. Moreover, the results suggest that future research should probably focus on explaining the apparent sub-optimal choices made by individuals in this area. Consequently, although some potential explanations (e.g. wrongly predicted adaptation, limited willpower and loss aversion) for some of our results have already been hypothesized in the literature, they have proven difficult to test so far. This brings us to the wider issue of the need to improve sources of information that challenge statistical authorities. These improved sources of information should make it easier to check potential explanations that have been scantly explored so far. Perhaps more relevantly at this stage in the field's research, these sources could also enable conducting cross-national studies. Such studies would start from the major lines of consensus reached so far on the

main relationships, to then quantify national/regional variations and explore the phenomena that explain such variations in a systematic and comparable way.

Acknowledgements

This work was supported by the Spanish Ministry of Economy and Competitiveness (MINECO) under Grants CSO2017-86474-R and CSO2014-55780-C3-2-P (National Plan for Research, Development and Innovation) (MINECO/AEI/ERDF, EU). A first version of this paper was presented at the NECTAR Cluster 4 Meeting "Travel, migration, housing and labour market in a context of crisis. Lessons for the future" (October 6-7, 2016, Toledo, Spain). We are grateful to the organisers of this event for their feedback. We are also very grateful to three anonymous reviewers and the editors for valuable written comments.

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Table 1.
Determinants of satisfaction. General analysis.

	Job satisfaction	Satisfaction with housing	Satisfaction with personal life	Satisfaction with leisure time
Length of commute/60	-0.492	-0.404	-0.412	-0.753
	(0.034)***	(0.033)***	(0.035)***	(0.047)***
Woman	0.088	-0.018	-0.128	-0.362
	(0.023)***	(0.022)	(0.023)***	(0.032)***
Age	-0.035	-0.059	-0.070	-0.047
	(0.008)***	(0.008)***	(0.008)***	(0.011)***
Age*Age	0.000	0.001	0.001	0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Native	0.054	0.078	0.002	0.043
	(0.024)**	(0.023)***	(0.024)	(0.033)
Secondary Education	0.039	0.175	0.076	0.043
	(0.030)	(0.029)***	(0.031)**	(0.042)
University Education	0.084	0.192	0.203	0.207
	(0.036)**	(0.035)***	(0.037)***	(0.050)***
Lives with working partner	0.034	0.277	0.687	0.105
	(0.031)	(0.030)***	(0.032)***	(0.043)**
Lives with non-working partner	0.160	0.221	0.578	0.178
	(0.031)***	(0.030)***	(0.032)***	(0.043)***
Lives with a child under 15 years	0.049	0.006	-0.153	-0.335
	(0.027)*	(0.026)	(0.028)***	(0.038)***
Household income (/1000)	0.152	0.189	0.143	-0.017
	(0.011)***	(0.011)***	(0.011)***	(0.015)
Constant	7.544	8.191	8.531	7.434
	(0.155)***	(0.151)***	(0.160)***	(0.215)***
N	25,957	25,957	25,957	25,957

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Note: Results of the estimation by multivariate regression of four different related models where dependent variables are satisfaction with job, housing, personal life and leisure time, respectively. The standard errors of the variables are robust.

Table 2.
Determinants of satisfaction.
Disaggregated analysis by economic cycle stage, size of municipality, density and economic sector.

	Job satisfaction	Satisfaction with housing	Satisfaction with personal life	Satisfaction with leisure time
Analysis by economic cycle stage				
Length of commute/60	-0.651	-0.224	-0.265	-0.972
	(0.054)***	(0.053)***	(0.056)***	(0.075)***
Length of commute/60*Crisis	0.222	-0.251	-0.205	0.305
	(0.058)***	(0.057)***	(0.060)***	(0.081)***
Analysis by economic cycle stage+Household income				
Length of commute/60	-0.532	-0.319	-0.320	-0.890
	(0.042)***	(0.041)***	(0.043)***	(0.058)***
Length of commute/60*Crisis*Household income under average	0.115	-0.182	-0.194	0.291
	(0.052)***	(0.050)***	(0.053)***	(0.072)***
Analysis by size of municipality				
Length of commute/60	-0.280	-0.148	-0.266	-0.547
	(0.062)***	(0.060)**	(0.064)***	(0.086)***
Length of commute/60*Size medium-low	-0.144	-0.106	-0.133	-0.177
	(0.072)**	(0.070)	(0.074)*	(0.100)*
Length of commute/60*Size medium	-0.226	-0.200	-0.128	-0.268
	(0.084)***	(0.082)**	(0.087)	(0.117)**
Length of commute/60*Size medium-high	-0.222	-0.271	-0.097	-0.113
	(0.069)***	(0.067)***	(0.071)	(0.095)
Length of commute/60*Size high	-0.392	-0.554	-0.319	-0.508
	(0.088)***	(0.086)***	(0.091)***	(0.123)***
Analysis by density				
Length of commute/60	-0.445	-0.301	-0.366	-0.693
	(0.037)***	(0.036)***	(0.039)***	(0.052)***
Length of commute/60*Density (/1000)	-0.019	-0.042	-0.019	-0.025
	(0.007)***	(0.006)***	(0.007)***	(0.009)***
Analysis by economic sector				
Length of commute/60	-0.603	-0.436	-0.475	-0.954
	(0.036)***	(0.035)***	(0.037)***	(0.050)***
Length of commute/60*Public sector	0.478	0.136	0.269	0.860
	(0.053)***	(0.052)***	(0.055)***	(0.074)***

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Note: Results of the estimation by multivariate regression of four different related models where dependent variables are satisfaction with job, housing, personal life and leisure time, respectively. The standard errors of the variables are robust. Explanatory variables have also been included as controls of gender, age, nationality, level of education, living with working partner, living with non-working partner, living with a child under 15 years old, household income, and, in the case of the disaggregated analysis by size of municipality and density, fixed effects by region. In the analysis by size of municipality Size low is the reference category.

Table 3.
Determinants of satisfaction.
Disaggregated analysis by gender.

	Job satisfaction	Satisfaction with housing	Satisfaction with personal life	Satisfaction with leisure time
Gender				
Length of commute/60	-0.472	-0.350	-0.358	-0.805
	(0.044)***	(0.043)***	(0.045)***	(0.061)***
Woman	0.112	0.068	0.048	-0.301
	(0.038)***	(0.043)	(0.045)	(0.058)***
Length of commute/60*Woman	-0.049	-0.133	-0.133	0.128
	(0.069)	(0.067)**	(0.071)	(0.096)
Gender + Children				
Length of commute/60	-0.482	-0.380	-0.386	-0.730
	(0.035)***	(0.034)***	(0.036)***	(0.049)***
Length of commute/60*Woman*Children<15	-0.075	-0.188	-0.202	-0.179
	(0.079)	(0.077)**	(0.081)**	(0.110)
Gender + Working partner				
Length of commute/60	-0.501	-0.416	-0.439	-0.747
	(0.036)***	(0.035)***	(0.037)***	(0.050)***
Length of commute/60* Woman*Working partner	0.058	0.079	0.177	-0.038
	(0.076)	(0.074)	(0.078)**	(0.106)

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Note: Results of the estimation by multivariate regression of four different related models where dependent variables are satisfaction with job, housing, personal life and leisure time, respectively. The standard errors of the variables are robust. Explanatory variables have also been included as controls of gender, age, nationality, level of education, living with working partner, living with non-working partner, living with a child under 15 years old, and household income.

Table 4.
Determinants of satisfaction.
Disaggregated analysis by mode of transport.

	Job satisfaction	Satisfaction with housing	Satisfaction with personal life	Satisfaction with leisure time
Disaggregated mode of transport				
Length of commute/60	-0.464	-0.279	-0.370	-0.839
	(0.044)***	(0.043)***	(0.045)***	(0.061)***
Length of commute/60*Bus	-0.133	-0.163	-0.158	0.181
	(0.065)***	(0.064)**	(0.067)***	(0.091)**
Length of commute/60*Metro/Tram	-0.313	-0.661	-0.378	-0.046
	(0.084)***	(0.082)***	(0.086)***	(0.117)
Length of commute/60*Train	0.040	-0.070	-0.071	0.259
	(0.082)	(0.080)	(0.085)	(0.114)**
Length of commute/60*Car (as passenger)	-0.186	-0.252	-0.025	0.225
	(0.089)**	(0.087)***	(0.092)	(0.125)*
Length of commute/60*Motorbike	-0.149	-0.224	-0.410	-0.615
	(0.179)	(0.174)	(0.184)**	(0.249)**
Length of commute/60*Walking/Bike	-0.417	-0.496	-0.246	0.138
	(0.116)***	(0.113)***	(0.119)**	(0.161)
Length of commute/60*Other	0.186	0.012	0.079	0.110
	(0.141)	(0.137)	(0.145)	(0.196)
Public vs. private mode of transport				
Length of commute/60	-0.421	-0.314	-0.373	-0.804
	(0.040)***	(0.039)***	(0.042)***	(0.056)***
Length of commute/60*Public transport	-0.098	-0.198	-0.085	0.131
	(0.049)**	(0.048)***	(0.050)*	(0.068)***

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Note: Results of the estimation by multivariate regression of four different related models where dependent variables are satisfaction with job, housing, personal life and leisure time, respectively. The standard errors of the variables are robust. Explanatory variables have also been included as controls of gender, age, nationality, level of education, living with working partner, living with non-working partner, living with a child under 15 years old, and household income. In the disaggregated analysis car driver is the reference category.

Appendix A

Table A.1.
Definition of variables.

Variable	Definition
Commute length	Time taken in minutes to travel between home and work
Commute over average	Dichotomous variable that indicates if the commuting time of the individual is over the average of the sample
Job satisfaction	Variable measured on a 0-10 scale corresponding to the question 'Indicate your degree of satisfaction in your current work'
Satisfaction with housing	Variable measured on a 0-10 scale corresponding to the question 'Indicate your degree of satisfaction with your dwelling'
Satisfaction with personal life	Variable measured on a 0-10 scale corresponding to the question 'Indicate your degree of satisfaction with your personal life'
Satisfaction with leisure time	Variable measured a 0-10 scale corresponding to the question 'Indicate your degree of satisfaction with your available leisure time'
Woman	Dichotomous variable that indicates if the individual is a woman
Age	Age in years
Native	Dichotomous variable that indicates if the individual has Spanish nationality
Secondary education	Dichotomous variable that indicates if the individual has secondary education
University education	Dichotomous variable that indicates if the individual has higher education
Lives with working partner	Dichotomous variable that indicates if the individual lives with a working partner
Lives with non-working partner	Dichotomous variable that indicates if the individual lives with a non-working partner
Lives with child under 15	Dichotomous variable that indicates if the individual lives with at least a child younger than 15
Household income	Household's monthly income in euros
Year	Four dichotomous variables that indicate the year that the wave of the survey corresponds to (2007 to 2010)
Crisis	Dichotomous variable that indicates if the year of the wave of the survey corresponds to the economic crisis (2008 to 2010) as opposed to the expansion (2007)
Region	Seventeen dichotomous variables that indicate the region where the individual resides
Size of municipality	Five dichotomous variables that indicate the size of the municipality where the individual resides (lower than 10,000; between 10,000 and 49,999; between 50,000 and 99,999; between 100,000 and 1,000,000; and over 1,000,000)
Density	Average population density of the municipalities with a similar size inside the region of residence (inhabitants per squared kilometre)
Public sector	Dichotomous variable that indicates if the individual works in the public sector
Mode of transport	Dichotomous variables that indicate what type of transportation the individual uses mainly to move daily to his/her work (car as a driver; motorbike; car as a passenger; bus; metro/tram; train; walking; bike; other)
Public mode of transport	Dichotomous variable that indicates whether the commuting mode is public (taxi; bus; metro/tram; train)
Salary	Monthly salary in euros
Hours worked per week	Hours worked in a normal week
Full time	Dichotomous variable that indicates if the individual works full time (vs. part-time)
Continuous working day	Dichotomous variable that indicates if the individual has a continuous working day
Works weekend	Dichotomous variable that indicates if the individual usually works on Saturday or Sundays
Works nights	Dichotomous variable that indicates if the individual usually works on nights
Permanent contract	Dichotomous variable that indicates if the individual has an indefinite (vs. fixed-term) contract
Seniority	Seniority in years of the individual in their current firm
Semi-skilled occupation	Dichotomous variable that indicates if the individual works in a semi-skilled occupation
Skilled occupation	Dichotomous variable that indicates if the individual works in a skilled occupation
Carries out supervisory tasks	Dichotomous variable that indicates if the individual has supervisory tasks
Overqualified	Dichotomous variable that indicates if the individual considers that his/her job requires less training than he/she has
Size of the company	Three dichotomous variables that indicate the size of the company (lower than 10; between 10 and 249; and higher than 249)
Level of routine at work	Variable measured on a 0-10 scale corresponding to the question 'Indicate the monotony-routine level of your current job'

Level of physical effort at work	Variable measured on a 0-10 scale corresponding to the question 'Indicate the level of physical effort of your current job'
Danger/perceived risk at work	Variable measured on a 0-10 scale corresponding to the question 'Indicate the level of risk or danger situations of your current job'
Health and safety at work	Variable measured on a 0-10 scale corresponding to the question 'Indicate the level of health and safety of your current job'

Table A.2.
Descriptive variables.

	Average	Standard deviation	Minimum	Maximum
Commute length (minutes)	21.78	19.07	0	180
Commute over average	0.33	0.47	0	1
Job satisfaction	7.28	1.74	0	10
Satisfaction with housing	7.72	1.71	0	10
Satisfaction with personal life	7.51	1.82	0	10
Satisfaction with leisure time	6.37	2.42	0	10
Woman	0.44	0.50	0	1
Age	41.25	10.68	16	65
Native	0.71	0.46	0	1
Secondary education	0.55	0.50	0	1
University education	0.27	0.44	0	1
Lives with working partner	0.34	0.47	0	1
Lives with non-working partner	0.31	0.46	0	1
Lives with child under 15 years old	0.35	0.48	0	1
Household income	1990,8	1142,4	450	7,500
Year 2007	0.24	0.43	0	1
Year 2008	0.26	0.44	0	1
Year 2009	0.25	0.43	0	1
Year 2010	0.25	0.43	0	1
Size of municipality < 10,000	0.20	0.40	0	1
Size of municipality 10,000-49,999	0.27	0.44	0	1
Size of municipality 50,000-99,999	0.12	0.33	0	1
Size of municipality 100,000-1,000,000	0.33	0.47	0	1
Size of municipality >1,000,000	0.08	0.27	0	1
Density	1.739,9	2954,5	9.7	16,307.5
Private sector	0.75	0.43	0	1
Mode of transport: Car (as driver)	0.56	0.49	0	1
Mode of transport: Motorbike	0.03	0.17	0	1
Mode of transport: Car (as passenger)	0.04	0.20	0	1
Mode of transport: Bus	0.08	0.08	0	1
Mode of transport: Metro/Tram	0.04	0.04	0	1
Mode of transport: Train	0.02	0.02	0	1
Mode of transport: Bike	0.01	0.01	0	1
Mode of transport: Walking	0.19	0.20	0	1
Mode of transport: Other	0.02	0.02	0	1
Salary	1334,4	708,5	450	7,500
Hours worked per week	38.94	87.82	1	168
Full time	0.87	0.34	0	1
Continuous working day	0.58	0.49	0	1
Works weekend	0.15	0.36	0	1
Works nights	0.14	0.35	0	1
Permanent contract	0.77	0.42	0	1
Seniority	10.16	10.32	0	49
Semi-skilled occupation	0.53	0.50	0	1
Skilled occupation	0.34	0.47	0	1
Carries out supervisory tasks	0.20	0.40	0	1
Overqualified	0.19	0.39	0	1
Company size 10-249	0.22	0.42	0	1
Company size 250 or more	0.55	0.50	0	1
Level of routine at work	4.89	3.12	0	10
Level of physical effort at work	4.52	3.22	0	10
Danger/perceived risk at work	3.56	3.21	0	10
Health and safety at work	7.31	2.16	0	10
Number of observations		25,957		

Table A.3
Average length of commute by satisfaction levels in different domains.

	Job satisfaction	Satisfaction with housing	Satisfaction with personal life	Satisfaction with leisure time
Satisfaction level				
0	25.9	23.7	24.9	23.3
1	26.1	26.0	29.5	25.2
2	27.3	24.8	27.9	24.5
3	23.6	24.4	22.5	24.8
4	25.9	24.6	24.6	24.8
5	24.6	24.2	23.6	22.1
6	23.0	23.9	23.5	22.2
7	22.1	22.4	22.0	21.3
8	21.0	21.4	21.3	19.9
9	20.6	21.0	20.9	19.9
10	18.6	19.6	20.0	19.1

Table A.4.
Determinants of satisfaction.
Alternative measurement of commuting.

	Job satisfaction	Satisfaction with housing	Satisfaction with personal life	Satisfaction with leisure time
General analysis				
Commuting higher than average	-0.299	-0.250	-0.259	-0.446
	(0.023)***	(0.022)***	(0.024)***	(0.032)***
Analysis by economic cycle stage				
Commuting higher than average	-0.206	-0.132	-0.153	-0.196
	(0.029)***	(0.028)***	(0.030)***	(0.040)***
Commuting higher than average*Crisis	0.092	-0.312	-0.280	0.132
	(0.046)**	(0.045)***	(0.047)***	(0.064)**
Analysis by size of municipality				
Commuting higher than average	-0.150	-0.103	-0.143	-0.235
	(0.030)***	(0.029)***	(0.030)***	(0.041)***
Commuting higher than average*Size medium-low	-0.231	-0.138	-0.232	-0.414
	(0.057)***	(0.055)**	(0.059)***	(0.079)***
Commuting higher than average*Size medium	-0.324	-0.244	-0.218	-0.525
	(0.072)***	(0.070)***	(0.074)***	(0.100)***
Commuting higher than average*Size medium-high	-0.310	-0.295	-0.191	-0.333
	(0.053)***	(0.052)***	(0.055)***	(0.074)***
Commuting higher than average*Size high	-0.535	-0.700	-0.452	-0.782
	(0.069)***	(0.067)***	(0.071)***	(0.096)***
Analysis by density				
Commuting higher than average	-0.259	-0.186	-0.224	-0.390
	(0.024)***	(0.024)***	(0.025)***	(0.034)***
Commuting higher than average*Density (/1000)	-0.029	-0.048	-0.026	-0.042
	(0.006)***	(0.006)***	(0.006)***	(0.009)***
Analysis by economic sector				
Commuting higher than average	-0.344	-0.398	-0.283	-0.530
	(0.024)***	(0.023)***	(0.024)***	(0.033)***
Commuting higher than average*Public sector	0.372	0.098	0.193	0.684
	(0.052)***	(0.051)**	(0.054)***	(0.072)***
Analysis by gender				
Commuting higher than average	-0.249	-0.194	-0.204	-0.402
	(0.026)***	(0.026)***	(0.027)***	(0.037)***
Commuting higher than average*Woman	-0.227	-0.254	-0.250	-0.203
	(0.061)***	(0.060)***	(0.063)***	(0.086)**
Analysis by commuting mode				
Commuting higher than average	-0.256	-0.189	-0.219	-0.418
	(0.025)***	(0.024)***	(0.026)***	(0.035)***
Commuting higher than average*Public transport	-0.190	-0.271	-0.175	0.123
	(0.045)***	(0.043)***	(0.046)***	(0.062)**

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Note: Results of the estimation by multivariate regression of four different related models where dependent variables are satisfaction with job, housing, personal life and leisure time, respectively. The standard errors of the variables are robust. Explanatory variables have also been included as controls of gender, age, nationality, level of education, living with working partner, living with non-working partner, living with a child under 15 years old, household income, and, in the case of the disaggregated analysis by size of municipality and density, fixed effects by region. In the analysis by size of municipality Size low is the reference category.

Table A.5.
Determinants of satisfaction.
Disaggregated analysis by level of household income.

	Job satisfaction	Satisfaction with housing	Satisfaction with personal life	Satisfaction with leisure time
A) Household income above average				
General analysis				
Length of commuting/60	-0.338	-0.313	-0.263	-0.793
	(0.053)***	(0.049)***	(0.052)***	(0.079)***
Analysis by economic cycle stage				
Length of commuting/60	-0.399	-0.227	-0.170	-0.710
	(0.089)***	(0.083)***	(0.088)*	(0.133)***
Length of commuting/60*Crisis	0.083	-0.118	-0.128	-0.114
	(0.099)	(0.092)	(0.098)	(0.147)
Analysis by gender				
Length of commuting/60	-0.278	-0.228	-0.208	-0.797
	(0.071)***	(0.066)***	(0.070)***	(0.106)***
Length of commuting/60*Woman	-0.135	-0.191	-0.122	0.009
	(0.106)	(0.099)*	(0.105)	(0.158)
B) Household income under average				
General analysis				
Length of commuting/60	-0.567	-0.448	-0.486	-0.731
	(0.043)***	(0.043)***	(0.045)***	(0.059)***
Analysis by economic cycle stage				
Length of commuting/60	-0.777	-0.245	-0.324	-0.783
	(0.067)***	(0.067)***	(0.070)***	(0.091)***
Length of commuting/60*Crisis	0.295	-0.286	-0.227	0.215
	(0.072)***	(0.072)***	(0.076)***	(0.098)***
Analysis by gender				
Length of commuting/60	-0.560	-0.400	-0.421	-0.801
	(0.055)***	(0.054)***	(0.057)***	(0.074)***
Length of commuting/60*Woman	-0.020	-0.127	-0.170	0.183
	(0.089)	(0.088)	(0.093)*	(0.120)

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Note: Results of the estimation by multivariate regression of four different related models where dependent variables are satisfaction with job, housing, personal life and leisure time, respectively. The standard errors of the variables are robust. Explanatory variables have also been included as controls of gender, age, nationality, level of education, living with working partner, living with non-working partner, living with a child under 14 years old, and household income.

Table A.6.
Determinants of job satisfaction.
Extended specification of model with characteristics of job positions.

	Total
Length of commute/60	-0.319
	(0.033)***
Woman	0.136
	(0.022)***
Age	-0.037
	(0.007)***
Age*Age	0.000
	(0.000)***
Native	0.040
	(0.020)**
Secondary education	0.019
	(0.029)
University education	-0.036
	(0.039)
Lives with working partner	0.077
	(0.027)***
Lives with non-working partner	0.105
	(0.028)***
Lives with child under 15 years old	0.026
	(0.024)
Household income (/1000)	0.007
	(0.012)
Salary	0.000
	(0.000)***
Hours worked per week	-0.011
	(0.002)***
Full time	0.222
	(0.036)***
Continuous working day	0.027
	(0.021)
Works weekends	-0.065
	(0.029)**
Works nights	-0.013
	(0.030)
Fixed contract	0.257
	(0.026)***
Seniority	-0.005
	(0.001)***
Semi-skilled occupation	0.076
	(0.033)**
Skilled occupation	0.081
	(0.040)**
Supervising	0.071
	(0.024)***
Overqualified	-0.672
	(0.027)***
Company size 10-249	-0.056
	(0.029)*
Company size 250 or more	0.016
	(0.026)
Level of routine at work	-0.083
	(0.003)***
Level of physical effort at work	-0.007
	(0.004)*
Danger/perceived risk at work	-0.014
	(0.004)***

Health and safety at work	0.293
	(0.006)***
Constant	6.250
	(0.160)***
N	25,957

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Note: Results of the estimation by ordinary least squares of a model where dependent variable is satisfaction with job. The standard errors of the variables are robust.

[i] In contrast, the components of the affective aspect of SWB (the presence of positive feelings and the absence of negative ones) pertain to short-term frames and refer to the emotions felt during an interval or activity episode (De Vos et al., 2013). Both dimensions of SWB, cognitive and affective, are influenced by commuting (Ettema et al., 2010), but the examination of this latter component has been central in the transport literature on commuting (recent examples are Morris and Guerra, 2015a and b), which has mainly focused on the impact of commuting duration and conditions on travel satisfaction. Such literature is reviewed by e.g. De Vos et al. (2013), who remark that making this distinction does not preclude the fact that questions about satisfaction may reflect some degree of affective experience, as the differentiation between reflection and affectivity is not absolute.

[ii] However, other authors such as Morris and Hirsch (2016) find that the link between congestion and a less positive mood is quite limited.

[iii] Worthy of note, due to the use of cross-sectional data, it is not possible to control for the influence of unobserved heterogeneity of individuals in the analysis, which would require longitudinal data. In any case, the existing evidence on the importance of this factor is not conclusive: when unobserved heterogeneity is controlled for through a fixed effects estimator with panel data, the effect of commuting on satisfaction changes in Dickerson et al. (2014), but the results are similar to those obtained through ordinary least squares for the pool of all the years in Stutzer and Frey (2008).

[iv] The walking and cycling categories were combined for the econometric analysis due to the small size of the latter group (1% of the sample) and given the fact that previous literature almost always considers them that way.

[v] Average commute time for employees in Spain is around 22 minutes, very similar to British and German times (24 and 22 min, respectively) reported by Dickerson et al. (2014).

[vi] One reviewer suggests that the reduction of the negative effect of commuting on satisfaction during the Great Recession could also be partially due to a possible selection bias of employees during the crisis and potential lower traffic congestion in that period.

[vii] As suggested by one reviewer, individuals using public transport, particularly those who are transport dependent, might have difficulty searching for work and, possibly, housing and, might therefore be less satisfied with both.

[viii] Although it goes beyond the scope of this article, analyzing the effect of commuting from a comparative point of view (i.e. relative to comparable workers in the same city/region) would be a very interesting extension of this study, as suggested by a reviewer.

Table A.7.
Impact of commuting on satisfaction.
Analysis across the distribution of satisfaction domains.

Length of commute/60	Percentile 10	Percentile 20	Percentile 30	Percentile 40	Percentile 50	Percentile 60	Percentile 70	Percentile 80	Percentile 90
Job satisfaction	-0.461	-0.467	-0.469	-0.469	-0.459	-0.459	-0.459	-0.499	-0.509
	(0.008)***	(0.009)***	(0.006)***	(0.006)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.004)***
Satisfaction with housing	-0.386	-0.384	-0.376	-0.380	-0.375	-0.370	-0.387	-0.415	-0.420
	(0.005)***	(0.006)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.005)***	(0.004)***
Satisf. with personal life	-0.397	-0.406	-0.409	-0.397	-0.398	-0.397	-0.419	-0.433	-0.442
	(0.005)***	(0.006)***	(0.006)***	(0.005)***	(0.005)***	(0.005)***	(0.006)***	(0.005)***	(0.005)***
Satisf. with leisure time	-0.766	-0.741	-0.746	-0.755	-0.743	-0.747	-0.729	-0.729	-0.752
	(0.016)***	(0.011)***	(0.011)***	(0.013)***	(0.010)***	(0.010)***	(0.008)***	(0.008)***	(0.011)***

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Note: Results of the estimation by multivariate regression of four different related models where dependent variables are satisfaction with job, housing, personal life and leisure time, respectively. The standard errors of the variables are robust. Explanatory variables have also been included as socio-demographic characteristics (age and age squared; nationality; level of studies; living with a working/non-working partner and/or child under 15 years old and household income).

Figure A.1.
Distribution of satisfaction variables. 2007-2010. ECVT.

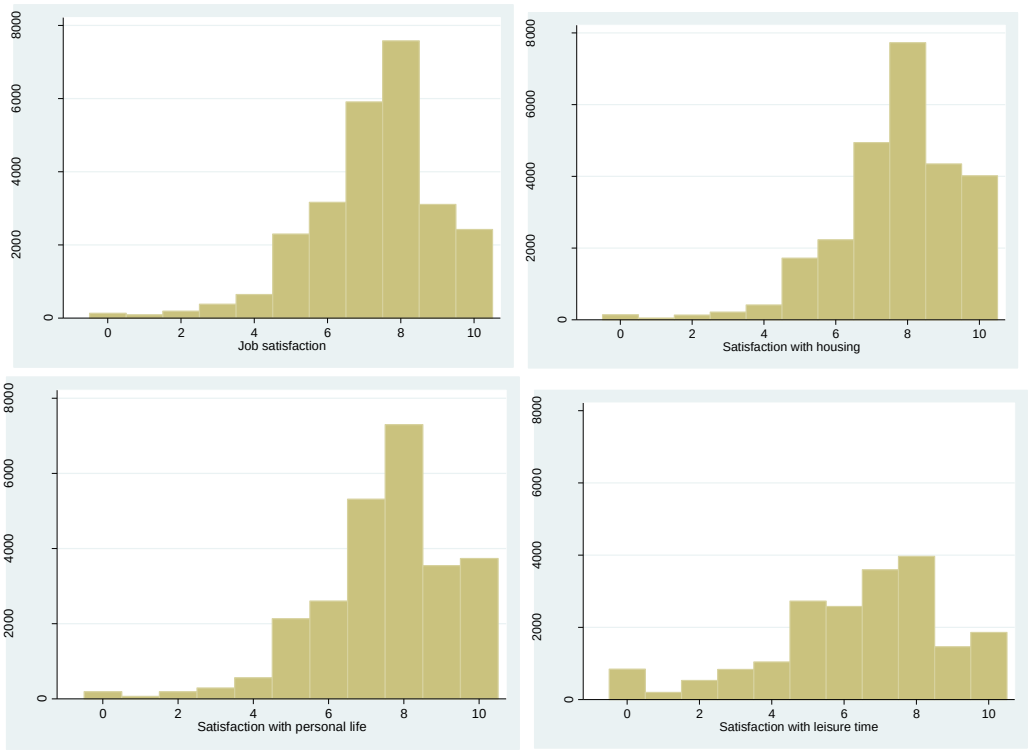


Figure A.2.
Distribution of travel time (length of commute). 2007-2010. ECVT.

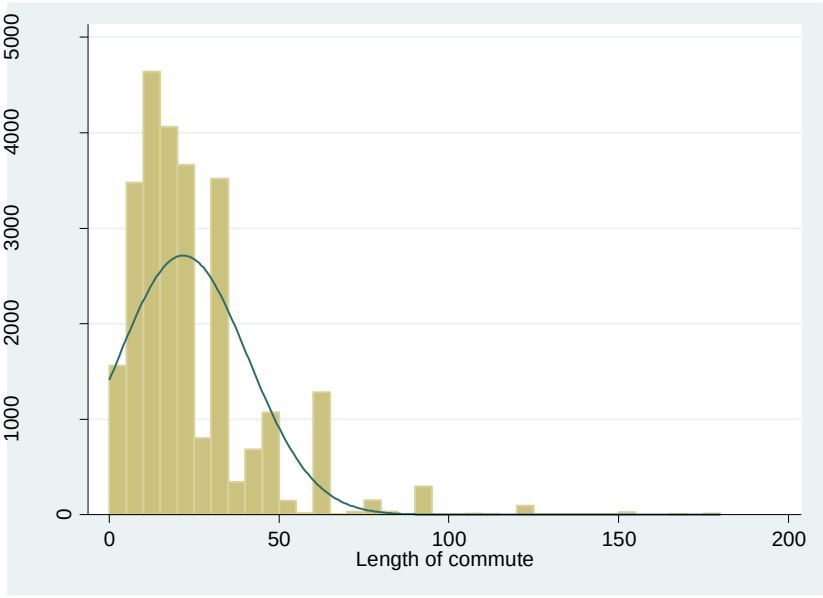
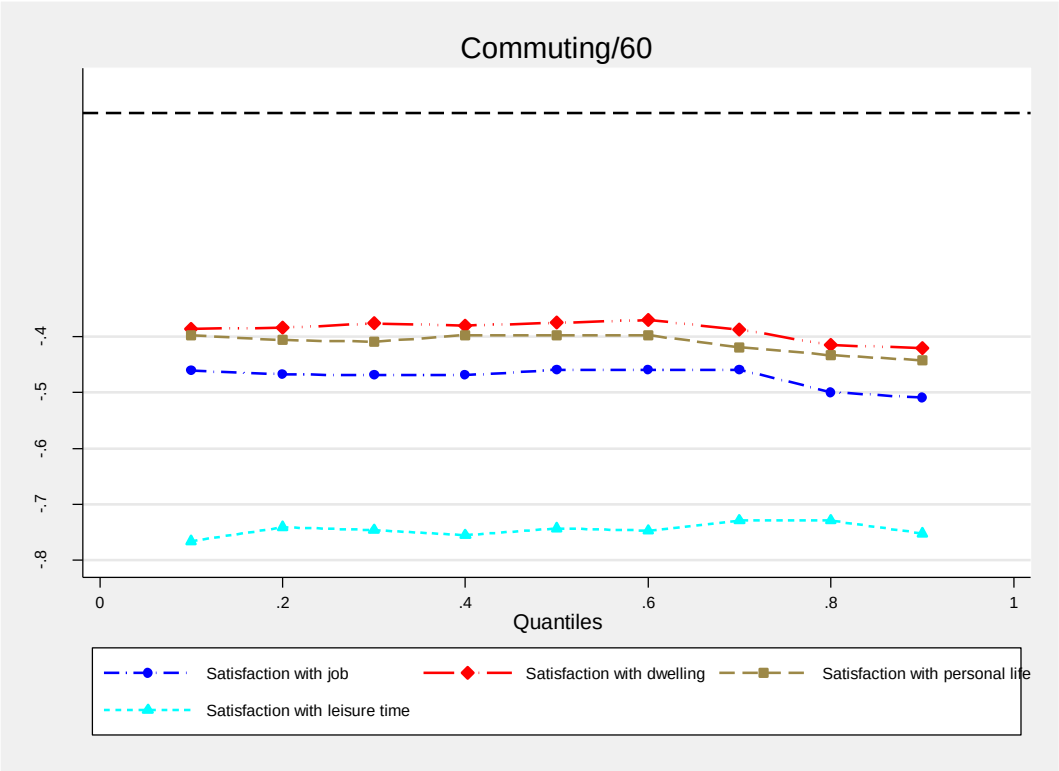


Figure A.3.
Impact of commuting on satisfaction.
Analysis across the distribution of the satisfaction domains.



Appendix B. Unconditional quantile regression

The method proposed by Firpo, Fortin and Lemieux (2009) estimates the effect of independent variables on the quantiles of the unconditional distribution of a dependent variable, unlike traditional methods of quantile regression, which estimate the effect on the conditional distribution of the dependent variable. This method consists of running a regression of the dependent variable (*W*; in our case satisfaction) when this is substituted by a transformation of itself, the *recentered influence function* (from now on, RIF).

The influence function is a tool traditionally used in the field of robust estimation, which measures the effect in distributional statistics of small changes in the underlying distribution.

Thus, for a distributional statistic given the distribution F_W, $v(F)$, this function measures the influence of an individual observation on that distributional statistic. Firpo, Fortin and Lemieux (2009) suggest using a recentered influence function after adding back the statistic of interest, $RIF(W)=v(F)+IF(W)$, given that its expectation is equal to $v(F)$ (insofar as expectation of the influence function regarding the distribution of *W* is, by definition, zero).

The influence function, $IF(W,Q_\theta)$, of the quantiles Q_θ of the unconditional marginal distribution F_W is defined as:

$$IF(W/Q_\theta)=\frac{\theta-I\{W<Q_\theta\}}{f_W(Q_\theta)} \tag{1}$$

Where $I\{\cdot\}$ is an indicator function and f_W is the density function of the unconditional distribution of *W* evaluated at Q_θ.

Given that the recentered influence function, $RIF(W,Q_\theta)$, is equal to $Q_\theta+IF(W,Q_\theta)$, therefore it follows on that:

$$RIF(W/Q_\theta)=Q_\theta+\frac{\theta-I\{W<Q_\theta\}}{f_W(Q_\theta)} \tag{2}$$

Hence, the RIF function can be computed empirically in the case of quantiles through a local inversion, after calculating the dummy variable $I\{W < Q_\theta\}$ (indicating whether the value of W is greater or lower than Q_θ), estimating the sample quantile Q_θ and estimating using the kernel density function of the corresponding density function f_W evaluated at Q_θ .

After calculating the RIF function for the quantiles, a value is generated for the transformed variable for each observation in the sample. Insofar as the impact of change on the distribution of an explanatory variable on the quantile can be expressed ceteris paribus as the average partial effect of that variable on the conditional expectation of its RIF function, and assuming that the conditional expectation of the RIF function can be modelled as a linear function of the explanatory variables, these values can be used for the estimation using an ordinary least squares regression of the RIF variable in a vector of explanatory variables. The estimated coefficients can be interpreted as the effect of an increase in the average value of an explanatory variable on the quantile of the unconditional distribution of an outcome variable, what Firpo, Fortin and Lemieux (2009) call unconditional quantile regression.